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(54) COMPOSITE UNITS FOR USE IN A UNIT FOR A PAPER-MAKING MACHINE

(71) We, FELDMÜHLE ANLAGEN- UND PRODUKTIONSGESELLSCHAFT MIT BESCHRANKTER HAFTUNG, a Body Corporate organised according to the laws of Germany, of Fritz-Vomfelde-Platz 4, Dusseldorf - Oberkassel, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which is is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a dewatering unit for a paper-making machine and to composite units for use in such dewatering units.

Wet suction units are dewatering units for the wet part of a paper-making machine, and can be employed instead of, or in addition to, table rollers or foils. They consist of a box construction, in which a reduced pressure is established by means of the gravity tube principle or by a vacuum pump. The box construction carries one or more bars which extend across the width of the machine. Dewatering is caused both by the action of the vacuum and by the wiping action of the edge of the bar(s).

Wet suction units are, as the name implies, built into the wet zone of a paper-making machine, that is to say they are located in a part of the wire section in which the sheet formation is not yet complete. An essential requirement to be met by a wet suction unit is therefore that it should achieve the optimum possible dewatering action without interfering with the sheet formation. A further requirement, which is especially important in connection with the economics of the machine, is that the frictional resistance between the wire and the covering of the wet suction unit should be as low as possible. The wearing out of the wire is known to be a major cost factor in the paper industry. Not only does the cost of the wire itself have to be taken into consideration, but so does the fact that the machine must be shut down for a considerable time while the wire is replaced. Thus, if it is possible to reduce the rate at which the wire wears out and hence to achieve a greater working life of the wire, a considerable advance is achieved.

Any attempt to increase the running speed of paper-making machines encounters considerable difficulties, especially in the dewatering zone of the machine. If table rollers are used, more of these are required when the speed is increased and in most installations it is impossible, because of the construction of the machine, simply to incorporate further table rollers, thus lengthing the wire section. Furthermore, because of the width of a paper-making machine, which is frequently considerable (modern machines commonly reach a width of 8 metres), the diameter of table rollers cannot be reduced without resulting in bending of the rollers and hence in new difficulties and it is therefore impossible to arrange a larger number of table rollers within the same space. A disadvantage of table rollers themselves is that a film of water is permanently carried along on the rollers and this film causes a hydraulic pressure surge and bending of the wire before the point of contact between the wire and the table roller. The result is that after the point of contact of the wire and the roller the suction zone is small, and consequently the dewatering capacity is low.

Because of the disadvantages inherent in the use of table rollers, foils and wet suction units are employed to an increasing extent in addition to, or instead of, table rollers in the dewatering zone of paper-making machines. When foils are used, the water is wiped off the wire by

[*Price 25p*]

the front edge of the foil, whilst the rear part of the foil, which gradually extends away from the underside of the wire at a small angle, either linearly or in an arc, sucks the water out of the paper web and the wire by means of the vacuum which is produced. The space required for the foil is less than that required for the table rollers. For the same length of the dewatering zone of the paper-making machine it is thus possible to achieve a considerably higher dewatering action; alternatively, the dewatering zone can be designed to be shorter for the same dewatering action.

The dewatering action of the foil can be regulated by changing the angular setting between the foil and the wire. This change usually requires a large amount of labour and, in the case of most installations, cannot be carried out whilst the machine is running. In most cases the angle can only be altered by replacing the foil bars or placing wedges under them. The action of a wet suction unit can, on the other hand, be regulated considerably more simply by merely changing the vacuum.

Wet suction units extend transversely over the entire width of the machine and are provided with a covering which is perforated or slit. In order to dewater the web which slides over them on the wire, they are connected to a vacuum, whereby the wire is pressed by the atmospheric pressure onto the surface of the covering. This results in relatively high wear on both the wire and on the covering of the wet suction unit. In order to achieve satisfactory working lives for the covering of the wet suction unit and for the wire, especially in the case of high speed machines and papers of high filler content, the covering of the wet suction unit may be made of a sintered hard substance.

It has already been proposed to provide dewatering devices with bars which extend over the entire width of the paper-making machine. For constructional reasons these bars must have a certain minimum width in order to be able to withstand the mechanical stress. Furthermore, the space between the bars in a wet suction unit must be great enough to allow the insertion of tools, since these bars can only be fitted from above, that is to say not from the suction chamber side. A good dewatering action is however only achieved if very narrow bars are employed and if the space between the bars corresponds to the width of the bars. The dovetail clamping which has hitherto been used in the case of hard materials is unsuitable, for size reasons. It is also very expensive, since the dovetail guide must be ground.

All the previously proposed dewatering devices which use bars consist of a rigid carrier, which when there are several dewatering bars arranged in series in the wire direction, is formed of a housing on which the dewatering bars (which consist of a sintered hard material) are mounted. The dewatering bars are divided into individual segments over the width of the paper-making machine wire, and these segments are relatively short in relation to the total width of the paper-making machine, having, for example, a length of 20 to 30 cm. Because these individual bars are arranged behind one another and next to one another, a new difficulty arises: it is very difficult to bring the wire-contacting surfaces of all these individual bars into one common plane in order to achieve a completely plane contact surface for the wire. The slightest deviations from a plane considerably reduce the running time of the wire. It is therefore necessary to carry out a finishing operation on the entire carrier in order to balance differences in height between the individual segments caused by unavoidable manufacturing tolerances. This finishing is very expensive and may lead to further difficulties, since the dewatering device is up to 8 m long (corresponding to the width of the wire). In general, the workshops in the paper-making industry are not equipped to carry out this grinding work mechanically. The trueing-up is thus in most cases carried out manually with a diamant-covered file. The accuracy and surface quality achievable is however inadequate.

The present invention provides a composite unit for use in a dewatering unit for a paper-making machine, the dewatering unit including a plurality of dewatering bars over which a wire can pass, the bars extending over the entire width of the paper-making machine, which composite unit comprises at least one elongate carrier which is adapted to be mounted with its longitudinal axis extending in the direction of travel of the wire, and, mounted on the carrier or carriers, at least two bar segments comprising a wear-resistant hard material, the bar segments being spaced from each other and being so mounted on the carrier that at least two parallel bars extending across the entire width of the machine can be formed by mounting a plurality of composite units adjacent to one another in the dewatering unit with their carriers extending in the direction of travel of the wire. The wear-resistant material is preferably a sintered material and advantageously has a hardness of at least 7 Mohs. Preferably, at least part of that surface of each segment that will be adjacent to the wire is substantially planar, the planar surface on each bar segment being substantially coplanar with the planar surface on the other bar segment. Advantageously, the or each carrier is in the form of a rod and the longitudinal axis of each bar segment is at approximately 90°C to the longitudinal axis of the or each carrier.

The invention also provides a dewatering unit for a paper-making machine which comprises a base and, mounted on the base, a plurality of composite units in accordance with the invention, the composite units being so arranged that a series of bars extending over the entire width of the paper-making machine is formed by juxtaposition of the bar segments. The invention further provides a dewatering unit of a paper-making machine, which dewatering unit includes an understructure having mounted thereon a plurality of dewatering bars over which a wire can pass, the bars being arranged in series in the direction of travel of the wire and extending over the entire width of the paper-making machine, at least the part of each bar that contacts the wire comprising a wear-resistant sintered hard material and the bars being subdivided into segments over the machine width, several segments in series, in the direction of travel of the wire, being mounted on at least one carrier, which carrier extends substantially in the direction of travel of the wire, and, over the width of the wire, several such composite units being mounted on the understructure.

By using the composite units of the invention, it is, in general, possible to ensure that the contact surface for the wire is absolutely plane. It is thus not necessary to carry out finishing work, bar by bar, over the frequently considerable widths of the dewatering units, but instead a unit, in a completely finished state, can be mounted on the suction chamber of the dewatering device. Furthermore, the time required for fitting the bars on the paper-making machine is reduced, the shut-down times for the machine are reduced, and the working period of the machine is considerably extended.

The sintered hard material is preferably sintered aluminium oxide, and the use of this material leads to a considerable increase in the durability of the wire and thereby also improves the degree of effectiveness of the machine. The suction action may be rendered uniform by providing very narrow bars. Since the bars do not have to be fitted individually (that is, since a number of bar segments are installed as a single unit), the space between the individual bars can also be kept narrow, and may for example, correspond to the width of the bars. The cost of grinding the bars of hard material may also be reduced because it is no longer necessary to grind any dovetails for clamping, and hence no additional working steps arise through the individual clamping of each dewatering bar.

The composite units are preferably connected in the dewatering unit in such a manner that they can be detached. The carrier of a composite unit can, for example, be a steel frame, the lateral limiting surfaces of which are each constructed as a dovetail guide. The replacement of such a complete unit only requires a few manipulations and can also be carried out rapidly by unskilled workers without any danger that the plane contact surface for the wire will be disturbed.

The individual segments in a composite unit are advantageously grouped together under tension. This can for example be effected by centrally supporting the individual segments on a tension rod that acts as the carrier the tension rod preferably being bolted at each end to a support. As a result of this prestressing it is possible to observe the dimensional tolerance considerably more accurately. The greater accuracy of the tolerances then results in easy replaceability of the complete composite units in the machine, and in an absolutely plane location relative to the wire.

The segment bars are preferably detachably connected to the carrier. If an individual segment, that is to say a part of a bar, is damaged, it is then possible to render the composite unit fully usable again by replacing this segment and grinding it to the general level of the composite unit.

The segments may be bolted to the carrier. Ceramics are usually bolted by tapping through the ceramic and providing the matching piece with the corresponding thread. This type of construction cannot be employed in dewatering devices, since the sheet formation on the wire is affacted by the open tappings. Furthermore, the segments may be trapeze-shaped in side view and thus be so narrow that there is not sufficient material available for tapping through. For this reason, a threaded tapping may be introduced into the segments before the sintering process, and after the sintering process a spiral spring may be mounted in the tapping in order to balance out non-unformities of the thread resulting from the sintering. This spiral spring then serves as the nut thread and receives the holding bolt.

Instead of being bolted to the carrier, the segments may advantageously be joined to the carrier by pins. If a pin joint is used, the amount of labour required is considerably reduced since it is not necessary to machine any threads in the segments, which threads are frequently not formed with the required accuracy because of the sintering process, so that either a finishing process or the insertion of further joint accessories such as spiral spring are necessary. Furthermore, pins are not so expensive with regard to material or labour as were the screws formerly used, and, because of their smaller dimensions, the pins may be inserted into smaller spaces in the carrier, without the carrier being further weakened by the necessary bore holes. When pins are used, moreover, the bore holes need not be through holes but can be blind bores with small diameters.

According to a particularly advantageous embodiment of the invention the pins take the form of notched pins which are securely attached to the carrier. The joining of the pin to the carrier is carried out by a simple pressing operation, or by driving the slightly tapered notched pin into the ready-made hole in the carrier, where it remains in a press fit.

The pins and the segments are preferably non-detachably joined together. The joints may be carried out by soldering, welding or cementing. It is particularly advantageous, however, to join the pin and segment by gluing, using a two component adhesive based on an epoxide resin. If a process such as gluing is used, the bore hole in the segment may initially be made larger than the largest external diameter of the tapered notched pin; the bore does not require finishing because of the coarse tolerances possible here, and irregularities being compensated by the two-component adhesive.

It it is not necessary for the segments to be detachably connected to the carrier, the segments may be glued to the carrier. A certain rigidity of the entire composite unit is achieved when this is done, and cross-bracings of the carrier is unnecessary.

All adhesive joints in the composite units of the invention are preferably coated in acid-proof chlorinated rubber. This coating guarantees a higher resistance to acids, since it prevents the adhesive from coming into direct contact with the media usually found in the water used in paper manufacture.

In a further embodiment of the invention, the carrier passes through at least one bush introduced into the segment. Using this arrangement it is possible, by attaching the individual segments, provided with bushes, to the carriers, to construct a composite unit very quickly, or to replace an individual segment. Since an accurate guiding of the individual segments on the carrier is guaranteed by the bushes, each segment, can be completely finished in the production plant, so that at the assembly point attachment to the carrier can be carried out in one operation.

The segments, which have a sharp butting edge and are usually inclined towards the wire are preferably fitted with bushes in such a manner that the latter overhang (extend beyond) the bounding surfaces of the segments on both sides. The overhang should appropriately be the same on each side and correspond to half the desired smallest distance between the individual segments. In this way it is possible for the separation of the segments to be only a few millimetres, so that in the wet suction apparatus high vacuum forces are applied without excessive strain on the paper-making machine wire caused as a result of the suction in the spaces between the segments.

It desired, for example when the machine is operated using a smaller vacuum than usual and with different materials, it is possible to arrange distance pieces (spacers) on the carrier between the bushes of neighbouring segments. By appropriate selection of these distance pieces it is possible to alter the distance between the different segments within a wide range, and in each case to comply with the required conditions. It is even possible, if one of the segments breaks when there are no segments in stock, to "replace" the broken segment by inserting several distance pieces between the other segments.

Advantageously, the bushes are arranged in the machine direction and are equidistant from the top and bottom of the segments. This enables both sides of the segments to be used and it is possible simply by turning the whole composite unit through an angle of 180° to construct a completely new unit straight away without replacing any of the segment pieces. The life duration of both the segments and the entire composite unit is thereby doubled.

The bush is preferably cemented into the segment. The individual segments, each of which has one or several bore holes (preferably at the height of the segment centre line), which bore holes are to contain the bush or bushes, need not be so accurately machined when this is done. Thus, the recesses for the bushes need not be refinished after sintering and are large enough, right from the beginning, so that as a result of the coarser tolerances, accurate adjustment of the bushes in alignment with the centre line is possible; these tolerances meet the required accuracy demands in the cementing of the bushes into the segments.

The bush is advantageously glued into the segment by means of a two component epoxide resin adhesive. In this case also there are substantial savings in labour costs, since the recess in the segment need not be machined. Two component epoxide resin adhesives generally cure quickly, thereby shortening the setting time necessary for the segment and the bush, so that the production of an individual segment is accelerated.

The carrier advantageously takes the form of tension bolts. As a result of this arrangement fasteners for the segments, which were formerly used to join a segment to a carrier, are rendered unnecessary. By unscrewing and screwing a single screw per carrier, all the segments attached to the carrier can be loosened or tightened: the time required to replace a segment is therefore reduced to a fraction of the time previously required

The invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a side view of one embodiment of the invention;

Figure 2 is a front view of the composite unit shown in Figure 1;

Figure 3 shows a portion, partly in cross-section, of another embodiment of the invention;

Figure 4 is a side view, partly in cross-section, of a third embodiment of the invention.

Referring now to the drawings, a composite unit 1 consists of several segments 12, which are arranged parallel to one another, in series in the wire direction, the segments 12 being at an acute angle to the wire direction. As a result of this acute contact angle a certain wiping effect is achieved at the front edge of the segments. It assists the dewatering action of the vacuum which is produced at the rear edge of the segments. The wire contact surface of the segments 12 is completely plane and the spacing of the segments 12 from one another is sufficiently small for a good suction action to be ensured, and sagging of the wire to be avoided.

As is best seen in Figure 2, each of the segments 12 is connected to a strap 10 by means of a fixing bolt 14 which extends into a tapping 13 in the segment 12. To balance any unevenness in the tappings 13, spiral springs (not shown) are introduced into these and these spiral springs at the same time serve as internal threads. Each strap 10 has a longitudinal slit 11, to permit the segment 12 to be adjusted along its length and thus to ensure satisfactory abutment of the composite unit 1 to the adjacent unit when a plurality of such units are mounted in a dewatering unit.

The straps 10 are welded to two carriers, 6 and 7 respectively, which are flat pieces of steel. Their cross-section narrows down like a knife edge, the straps 10, which are overlapped by the segments 12, being mounted at the knife edge. As a result of this knife edge construction of the carriers 6 and 7, the dewatering is favourably affected because there is no shadow formation in the paper or fleece pulp web attributable to uneven suction conditions caused by the carriers 6 and 7. Each of the carriers 6 and 7 has a recess 15 and a projection 2 at each end. The projection 2 engages a clamping claw 3, which is fixed by means of a bolt 5 to an understructure 4. If segments 12 are employed which do not provide the requisite stiffness of the composite unit 1, the composite unit 1 is strengthened by cross-members 8 and 9, which connect the carriers 6 and 7 to one another at two points.

Figure 3 shows an embodiment of the invention in which the carrier 6 has a notched pin 18 driven into it. The notched pin 18 is surrounded in its upper region by a layer 17 of a two-component adhesive based on an epoxide resin, by means of which it is securely joined to the segment 12. Segment 12 is also joined to the carrier 6 by means of an adhesive layer 16. Movements which may occur as a result of the elasticity of the two-component adhesive during gluing, are to a great extent prevented in this manner.

Figure 4 shows a wet suction apparatus taking the form of a dewatering unit in which the segments 12 are joined to a bush 23, by means of an adhesive layer 25. The adjacent segments 12 are spaced from one another by distance pieces 19. By means of the carrier which takes the form of a tension bolt and terminates in nuts 21, all segments are fixed in their relative position to one another and are joined to a mounting support 22. The mounting support 22 is welded to the base (understructure) of the suction box (not illustrated).

WHAT WE CLAIM IS:—

1. A composite unit for use in a dewatering unit for a paper-making machine, the dewatering unit including a plurality of dewatering bars over which a wire can pass, the bars extending over the entire width of the paper-making machine, which composite unit comprises at least one elongate carrier which is adapted to be mounted with its longitudinal axis extending in the direction of travel of the wire, and, mounted on the carrier or carriers, at least two bar segments comprising a wear-resistant hard material, the bar segments

being spaced from each other and being so mounted on the carrier that at least two parallel bars extending across the entire width of the machine can be formed by mounting a plurality of composite units adjacent to one another in the dewatering unit with their carriers extending in the direction of travel of the wire.

2. A composite unit as claimed in claim 1, wherein the hardness of the wear-resistant material is 7 Mohs.

3. A composite unit as claimed in claim 1, wherein the wear - resistant material is sintered aluminium oxide.

4. A composite unit as claimed in any one of claims 1 to 3, wherein the or each carrier is in the form of a rod and the longitudinal axis of each bar segment is at approximately 90° to the longitudinal axis of the or each carrier.

5. A composite unit as claimed in any one of claims 1 to 4, wherein the or each carrier is such that the composite unit can be detachably connected to the base of the dewatering unit.

6. A composite unit as claimed in claim 5, so far as it is dependent on any one of claims 1 to 3, wherein the carrier comprises a steel frame, the lateral limiting surfaces of which are each constructed as a dovetail guide.

7. A composite unit as claimed in any one of claims 1 to 6, wherein the bar segments are under tension.

8. A composite unit as claimed in any one of claims 1 to 6, wherein the bar segments are prestressed.

9. A composite unit as claimed in any one of claims 1 to 8, wherein the bar segments are detachably connected to the or each carrier.

10. A composite unit as claimed in claim 9, wherein each bar segment is bolted to the or each carrier by one or more bolts, each bolt releasably engaging the interior of a respective threaded tapping in the bar segment.

11. A composite unit as claimed in claim 10, wherein a spiral spring is positioned within each tapping.

12. A composite unit as claimed in claim 1, wherein each bar segment is connected to the or each carrier by one or more pins.

13. A composite unit as claimed in claim 12, wherein the pins are notched pins.

14. A composite unit as claimed in claim 12 or claim 13, wherein each pin is non-detachably joined to the respective bar segment and is releasably received in a respective bore in the carrier.

15. A composite unit as claimed in claim 14, wherein each pin is joined to the respective bar segment by a two-component adhesive based on an epoxy resin.

16. A composite unit as claimed in any one of claims 12 to 15, wherein each bar segment is glued to the or each carrier.

17. A composite unit as claimed in claim 15 or claim 16, wherein the or each adhesive joint is coated with an acid-proof chlorinated rubber.

18. A composite unit as claimed in claim 1, wherein each bar segment is provided with at least one bush the carrier, or each of the carriers, passing through the, or a respective, bush.

19. A composite unit as claimed in claim 18, wherein each bush extends beyond, on both sides, the bounding surfaces of the segment to which it is attached.

20. A composite unit as claimed in claim 18 or claim 19, wherein a spacer is positioned on the or each carrier between any two adjacent bar segments.

21. A composite unit as claimed in any one of claims 18 to 20, wherein each bush is situated midway between the top and the bottom edges of the respective bar segment, each of the top and bottom edges having a substantially planar surface and being substantially coplanar with the planar surface on the top or the bottom, as the case may be, of the other bar segments.

22. A composite unit as claimed in any one of claims 18 to 21, wherein each bush is connected to the respective bar segment.

23. A composite unit as claimed in any one of claims 18 to 21, wherein each bush is glued to the respective bar segment by means of a two-component epoxide resin adhesive.

24. A composite unit as claimed in any one of claims 18 to 23, wherein the or each carrier comprises a tension rod.

25. A composite unit as claimed in any one of claims 1 to 24, wherein at least part of that surface of each bar segment that will be adjacent to the wire is substantially planar, the planar surface of each bar segment being substantially coplanar with the plane surface(s) of the other bar segment(s).

26. A composite unit constructed substantially as described herein with reference to and as illustrated by Figures 1 and 2 of the accompanying drawings.

27. A composite unit constructed substantially as described herein with reference to and as illustrated by Figure 3 of the accompanying drawings.

28. A composite unit constructed substantially as described herein with reference to and as illustrated by Figure 4 of the accompanying drawings.

29. A dewatering unit for a paper-making machine which comprises a base

and, mounted on the base a plurality of composite units as claimed in claim 1, the composite units being so arranged that a series of bars extending over the entire width of the paper-making machine is formed by the juxtaposition of the bar segments.

30. A dewatering unit as claimed in claim 29, wherein each composite unit is releasably connected to the base.

31. A dewatering unit as claimed in claim 29, wherein each composite unit is as claimed in any one of claims 2 to 11, 25 and 26.

32. A dewatering unit as claimed in claim 29, wherein each composite unit is as claimed in any one of claims 12 to 17 and 27.

33. A dewatering unit as claimed in claim 29, wherein each composite unit is as claimed in any one of claims 18 to 24 and 28.

34. A dewatering unit of a paper-making machine, which dewatering unit includes an understructure having mounted thereon a plurality of dewatering bars over which a wire can pass, the bars being arranged in series in the direction of travel of the wire and extending over the entire width of the paper-making machine, at least the part of each bar that contacts the wire comprising a wear-resistant sintered hard material and the bars being subdivided into segments over the machine width, several of the segments in series, in the direction of travel of the wire, being mounted on at least one carrier, which carrier extends substantially in the direction of travel of the wire, to form a composite unit and, over the width of the wire, several such composite units being mounted on the understructure.

35. A paper-making machine which includes a dewatering unit as claimed in claim 29.

ABEL & IMRAY,
Chartered Patent Agents,
Northumberland House,
303-306, High Holborn,
London, WC1V 7LH.

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FIG.1

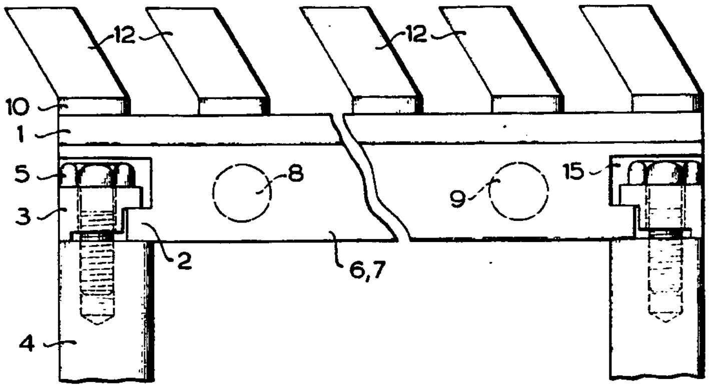
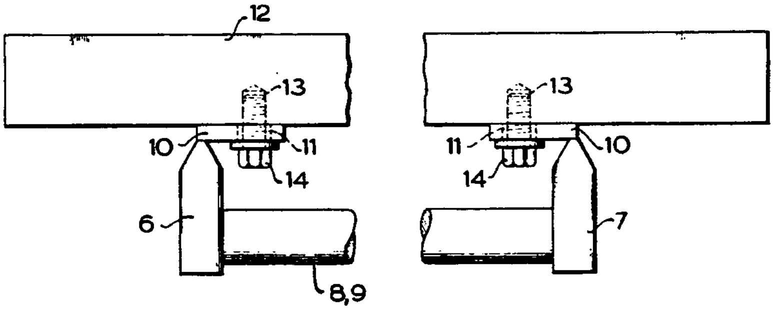


FIG.2



1344348 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

FIG. 3

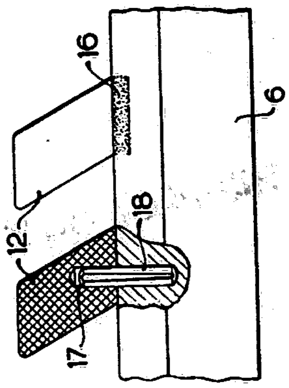
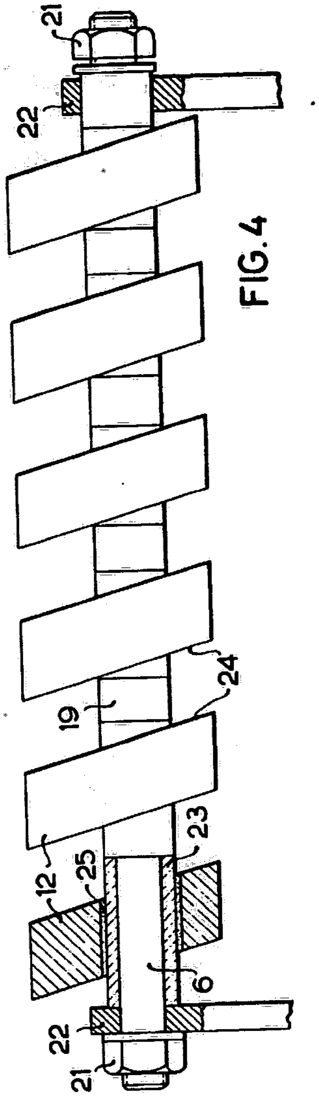


FIG. 4



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Applicant: Bartelmuss et al.

Lerner Greenberg Stemer LLP
Post Office Box 2480
Hollywood, FL 33022-2480
Tel: (954) 925-1100 Fax: (954) 925-1101